

## Technology Readiness Level (TRL) Descriptions

TRL Level and Title	Description	Assessment Criteria
TRL 1 - Basic principles observed and reported	A technology's basic properties is explored. Basic principles observed and reported. Scientific research begins to be translated into applied research and development (R&D). An example includes paper studies of a technology's basic properties.	Scientific research begins to be translated into applied research and development
TRL 2 - Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented or identified. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies and publications, or other references that outline the application being considered and that provide analysis to support the concept.	Invention begins, practical applications are identified but speculative, no experimental proof or detailed analysis
TRL 3 - Analytical and experimental critical function and/or characteristic proof of concept	Active R&D is initiated. Components are not yet integrated or representative. Examples include analytical studies to set the technology into an appropriate context and laboratory studies to physically validate that the analytical predictions of separate elements of the technology are correct.	Active research and development are initiated, including analytical and laboratory studies to validate predictions
TRL 4 - Component validation in laboratory environment	Basic technological components are integrated to establish that they will work together. Activities are devised to support the concept that was formulated earlier and should also be consistent with the requirements of potential system applications. This is relatively "low fidelity" compared with the eventual system. Example includes integration of "ad hoc" hardware in the laboratory.	Basic technological components are integrated to establish that they will work together
TRL 5 - Component validation in relevant environment	Fidelity of technology significantly increases. The basic technological components are integrated with reasonably realistic supporting elements so that the total applications (component-level, sub-system level, or system-level) can be tested in a 'simulated' or somewhat realistic environment. An example includes laboratory integration of components.	The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment.
TRL 6 - System/ subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, beyond TRL 5, is tested in a relevant environment. Represents a major step-up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment
TRL 7 - System prototype demonstration in an operational environment	Prototype is near or at planned operational system. Represents a significant step-up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, or in a facility). An example includes prototype field testing.	Prototype near or at planned operational system, demonstrating the technology in an operational environment
TRL 8 - Actual technology/system completed and qualified through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. An example includes developmental test and evaluation of the system in its intended system to determine if it meets design specifications.	Actual technology completed and qualified through test and demonstration
TRL 9 - Actual technology/system proven through successful operations	Actual application of the technology in its final form and under real-life conditions, such as those encountered in operational tests and evaluations. Examples include using the innovation under operational conditions, or in a competitive manufacturing environment.	Actual application of the technology is in its final form and under mission conditions, such as those encountered in operational test and evaluation